Renewables Transmission Planning

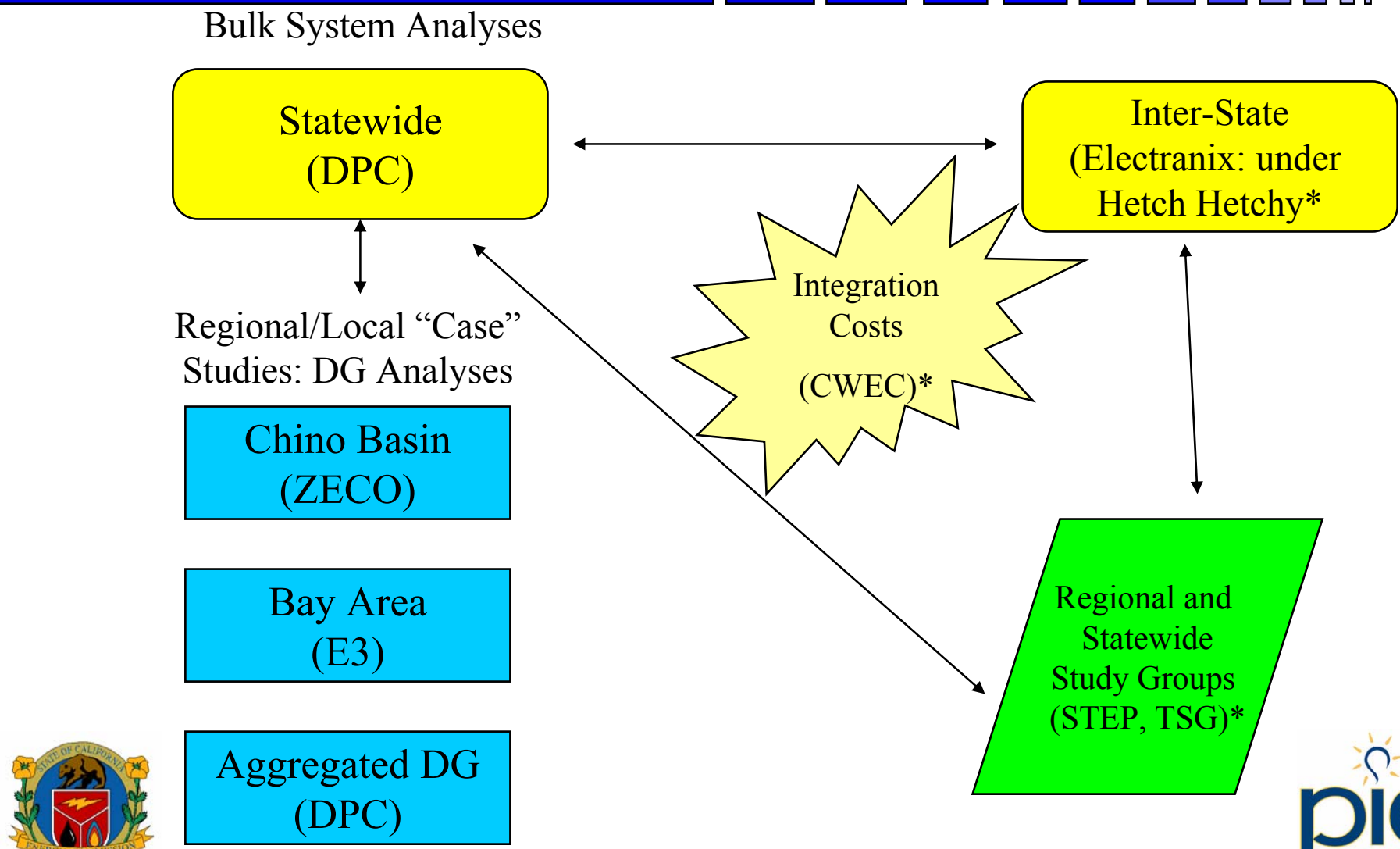
IEPR Workshop
September 14, 2004

George Simons
Manager, PIER Renewables

Overview of Renewables Transmission Planning

- ***Method for linking transmission needs and renewable resources***
- ***Number of components***
  - ***Transmission evaluation in combination with renewable resource availability within the state***
    - ***Local level for renewable distributed generation***
    - ***Regional and state looking at centralized (bulk) renewables***
  - ***Import of renewables from outside California***
  - ***Evaluating the costs of integrating renewables***
  - ***Regional and statewide transmission study groups***

Fitting the Components Together



Proposed Workshops on Various Components

Workshop Date	Topic
9/14/04	Bulk and Renewable DG Evaluation Tools, Methods and Data
10/04	Renewables Imported into California
10/04	Costs of Integrating Renewables: Simplified Methods Approach
10/04	Costs of Integrating Renewables: Multi-Year Results on Regulation, Load Following and Capacity
11/04	Local, State and Regional Renewable Transmission Study Groups

Purpose of Today's Meeting

- ***Review work being done on renewables transmission planning at the bulk and DG levels***
- ***Obtain a better understanding of questions, concerns or issues associated with:***
  - ***Approach***
  - ***Methods***
  - ***Data or assumptions***
- ***Begin integrating this work into the 2005 IEPR process***

pier
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Today's Agenda

◆ *9:00 - 9:15:*	*Overview*	*G. Simons*
◆ *9:15 - 11:30:*	*Statewide Approach*	*R. Davis*
◆ *11:30 - 12:00*	*Questions & Discussion*	
◆ *12:00 – 1:00*	*Lunch*	
◆ *1:00 – 1:15*	*Overview: Renewable DG*	*G. Simons*
◆ *1:15 - 2:00*	*Distributed Generation Assessment (Bay Area)*	*S. Price*
◆ *2:00 - 2:45*	*Mini-Grid in the Chino Basin*	*H. Zaininger*
◆ *2:45 - 3:00*	*Break*	
◆ *3:00 – 3:45*	*Aggregated Renewable DG*	*R. Davis*
◆ *3:45 - 4:15*	*Public Questions, Discussion and Next Steps*	

Purpose of Renewables Transmission Planning

- ***Provides a set of tools for planning renewable transmission development in California***
  - ***Allows evaluation of transmission options and potential costs***
    - ***At state, regional and local levels***
  - ***Enables developers and utilities to assess possible "opportunities" and impacts for procurement process***
  - ***May help establish a common basis for evaluating impacts and opportunities across utility borders and technology arenas***
  - ***May be valuable in assessing "least cost, best-fit" RPS goals***

What Isn't Covered

- ***Dispatch***
  - ***Analyses to date have focused on static power flow models***
  - ***No production cost modeling***
- ***Reactive Power***
  - ***To date, only real power analyses***
- ***Fully Integrated Set of Renewables***
  - ***So far, looking at wind vs. geothermal vs. biomass, etc.***
  - ***Fully integrated give better overall scenarios***

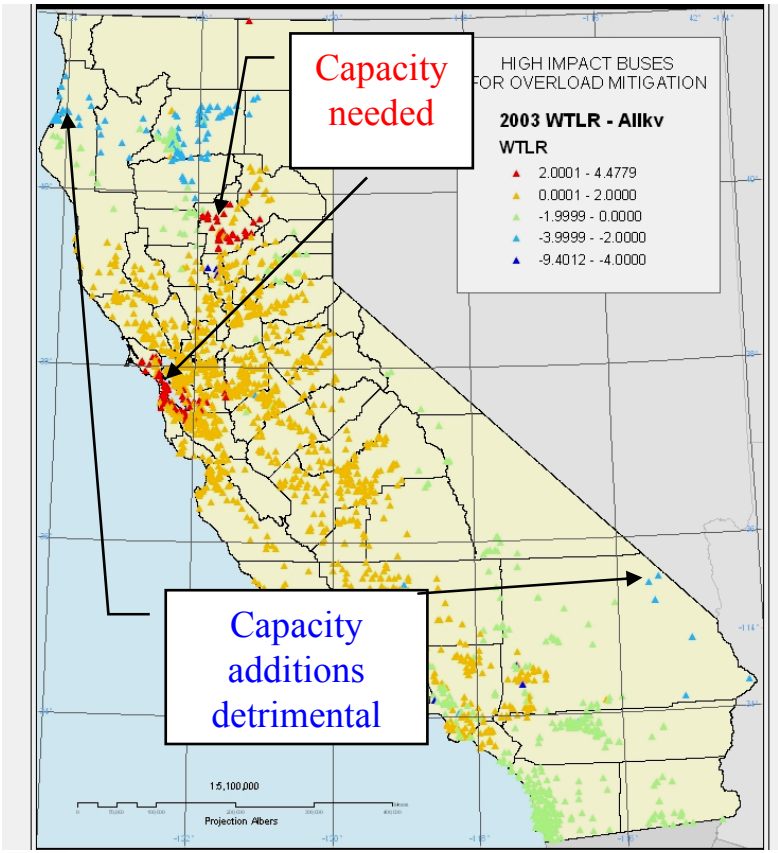
pier
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Summary of PIER Renewables Analyses to Date (SVA)

- *Identify, quantify and map electricity system needs out through 2017 (capacity, reliability, transmission)*
  - *Selected years (2003, 2005, 2007, 2010 & 2017)*
- *Identify and map out renewable resources*
  - *Wind, geothermal, solar, biomass and water (hydro & ocean)*
- *Project environmental, cost and generation performance of renewable technologies through 2017*
  - *Projections developed by PIER Renewable staff; corroborated by work done by EPRI, NREL and Navigant*
- *Conduct combined GIS and economic analyses to obtain "best-fit, least-cost" approach*
- *Develop RD&D targets that help drive forward renewables capable of achieving identified benefits*

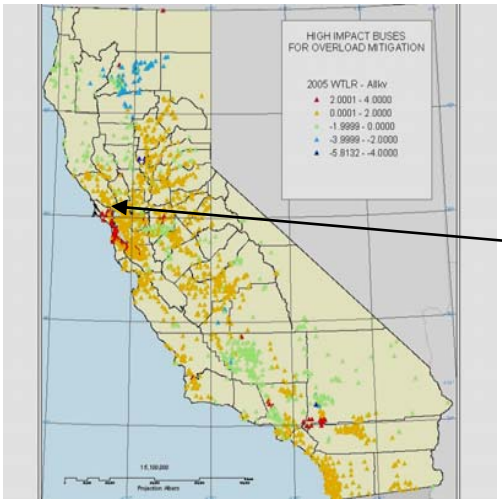
pier
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Electricity System: 2003



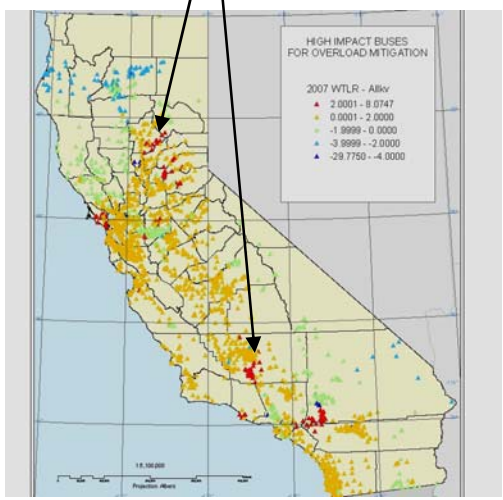
- *"Calibrates" model*
  - *Identifies potential "hot spots" in system via branch overloading*
  - *Weighted Transmission Loading Relief (WTLRs) identified via buses*
    - *Identifies where to add capacity*
      - *Red: capacity needed & provides system benefit*
      - *Yellow: capacity needed, but smaller system benefit*
      - *Blue: capacity additions are detrimental*
- *Results:*
  - *170 contingencies that cause security limit violations*
  - *255 violations aggregated in 146 "hot spots"*
  - *Overall security indicator equivalent to potential 8550 MW overload*
  - *Mostly located in PG&E (2/3rd) and SCE (1/3rd) territories*

Electricity System: 2005 - 2007



2005 System

Expanding need for capacity additions

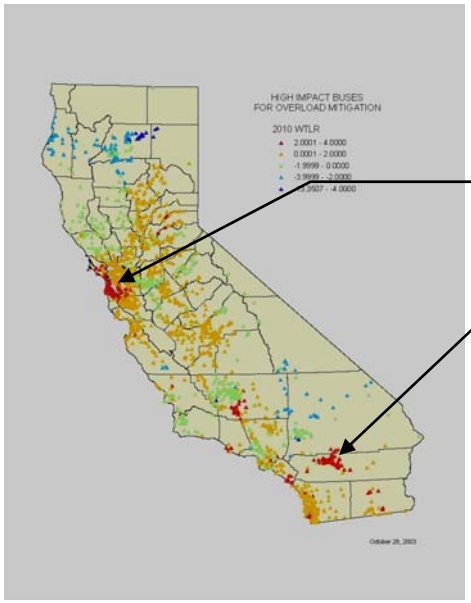


2007 System

- ***Assumptions:***
  - ***Summer peak scenario***
  - ***Demand for 2007 extrapolated from 2003 & 2005 demand levels***
  - ***New generation units in 2005 and 2007 based on CEC demand data and new generation facilities input***
    - ***Electricity Analysis Office***
    - ***Transmission Group***
- ***Results:***
  - ***Continued growth in possible overloads***
    - ***2005: 219 contingencies with 10,439 MW overload potential***
    - ***2007: 215 contingencies with 13,876 MW overload potential***

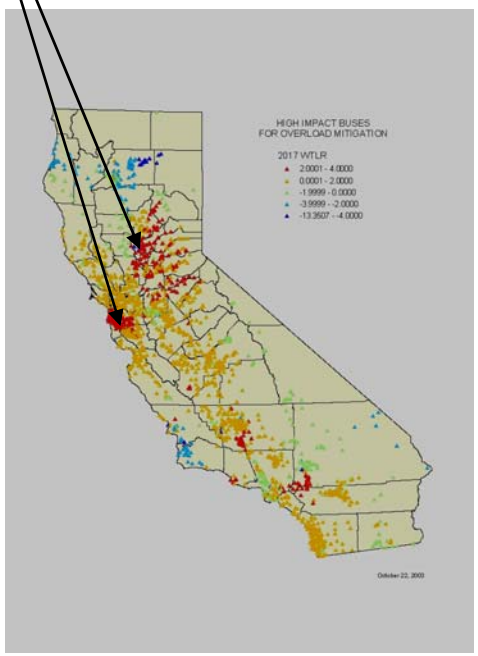
pier
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Electricity System: 2010 & 2017



2010 System

Increasing severity & numbers of reliability problems



2017 System

- ***Assumptions:***
  - ***Summer peak scenario***
  - ***Demand for 2010 and 2017 extrapolated from 2007 demand levels***
  - ***New generation units in 2010 and 2017 based on CEC input on new generation and transmission***
- ***Results:***
  - ***Continued growth in possible overloads***
    - ***2010: 409 contingencies with 17,256 MW overload potential***
    - ***2017: 674 contingencies with 30,657 MW overload potential***

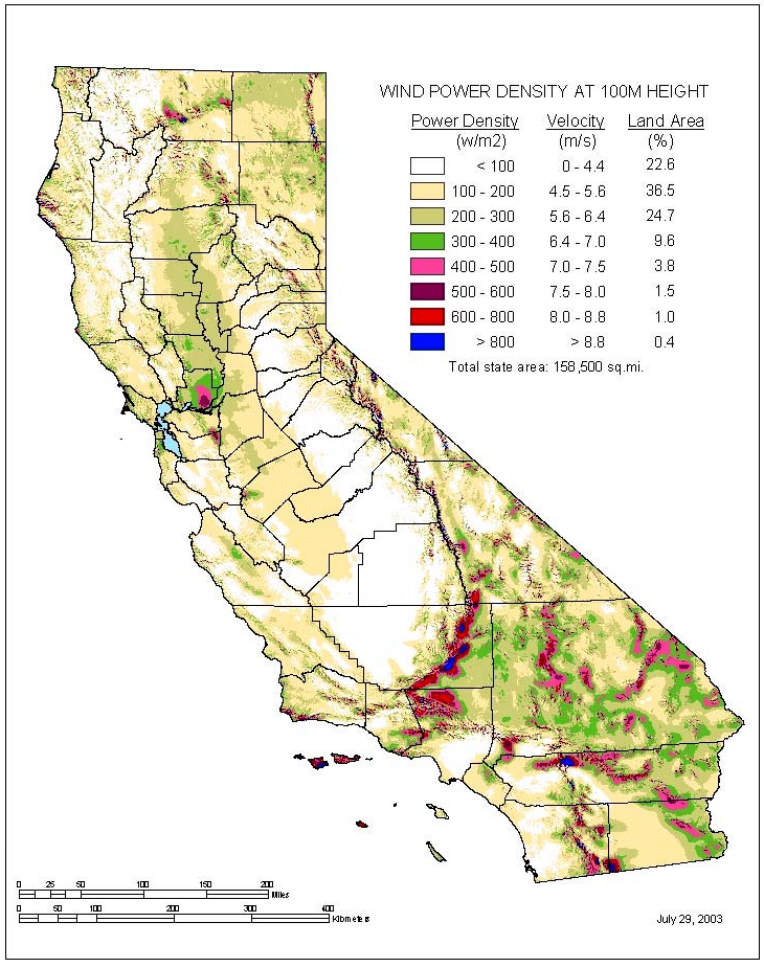
pier
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Mapping CA's Renewable Resources

- ***Identify the types and amounts of renewables that can help resolve "hot spots"***
- ***Existing data old, inaccurate and not readily useful***
  - ***Based on 1980 or earlier information***
  - ***Lacked geographical precision and coverage***
  - ***Not transferable to GIS***
- ***New resource assessments developed with updated information and in GIS format***
  - ***Wind***
  - ***Geothermal***
  - ***Biomass***
  - ***Solar***
  - ***Hydro***

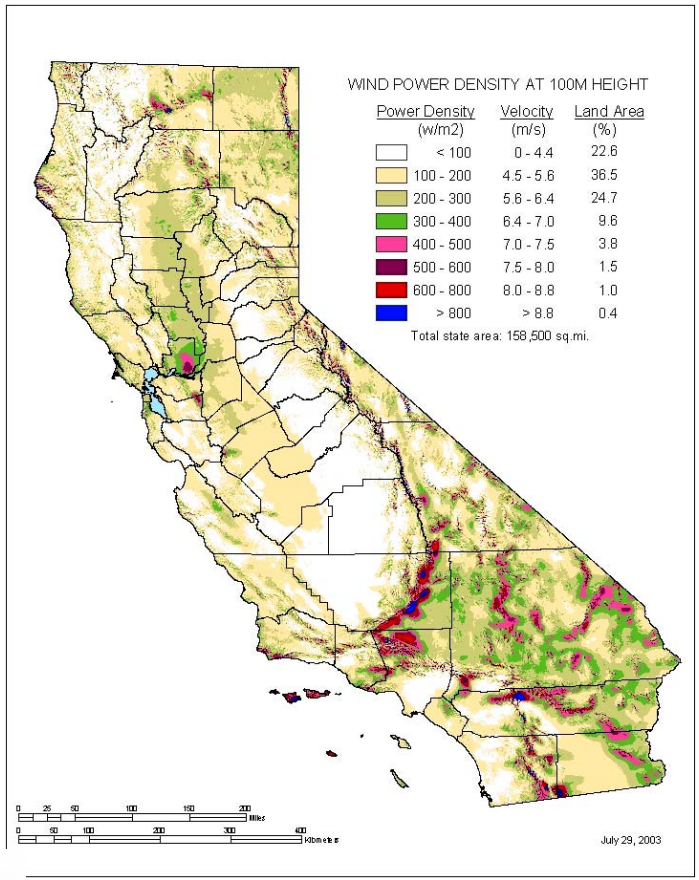
pier
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

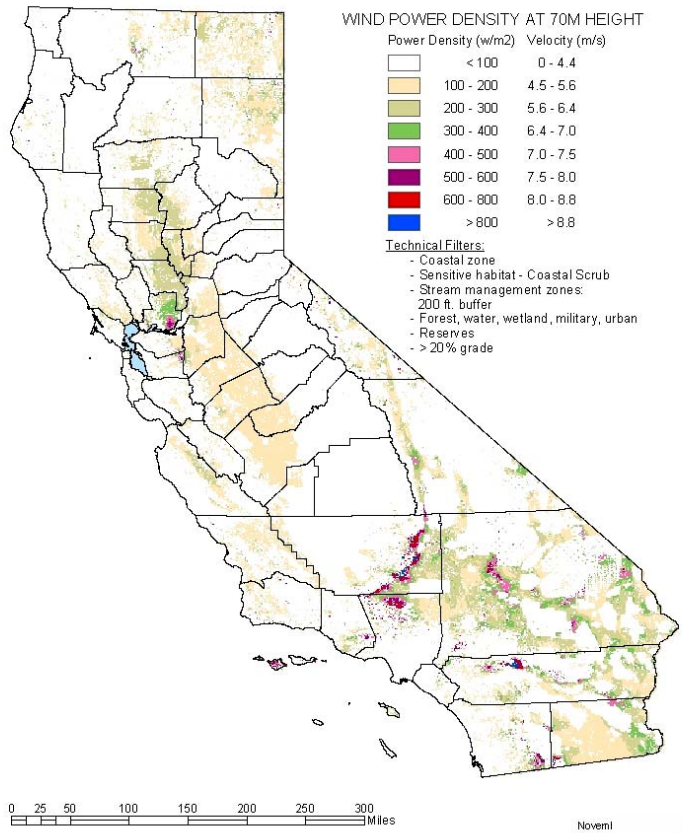
Example Results: High Resolution New Wind Resource Map



- *New wind resource assessment in 2000*
  - *Predictive model*
  - *200 x 200 meter resolution*
  - *Over a billion points statewide*
- *Information:*
  - *Wind speed at four heights*
  - *Wind power density*
- *Differentiation of high and low wind speed resources*

Allows Visual Comparison of Gross vs Technical Wind Potentials

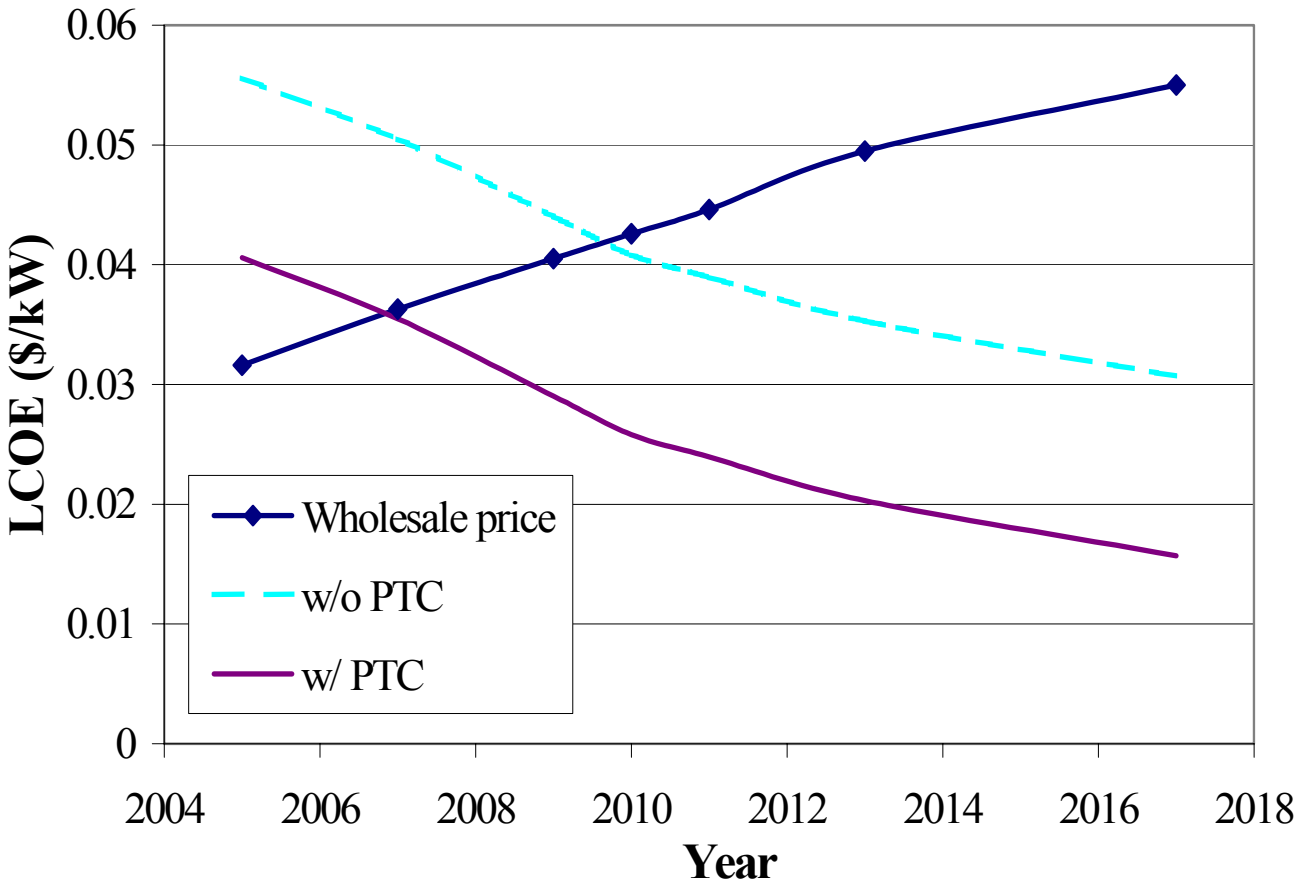




Example: Projecting Wind Renewable Performance and Costs

- ***Performance projections based on:***
  - ***Historical CA wind performance (WPRS)***
  - ***Technology development trends***
    - ***NREL, EPRI, Navigant information***
  - ***Assumes moderate development of wind turbine technology***
    - ***Primarily larger turbines with broader wind speed regimes***
- ***Cost projections based on:***
  - ***Continued manufacturing cost reduction trends***
  - ***Technology development trends***
    - ***NREL, EPRI & Navigant information***
  - ***Extrapolated to future using LCOE basis***

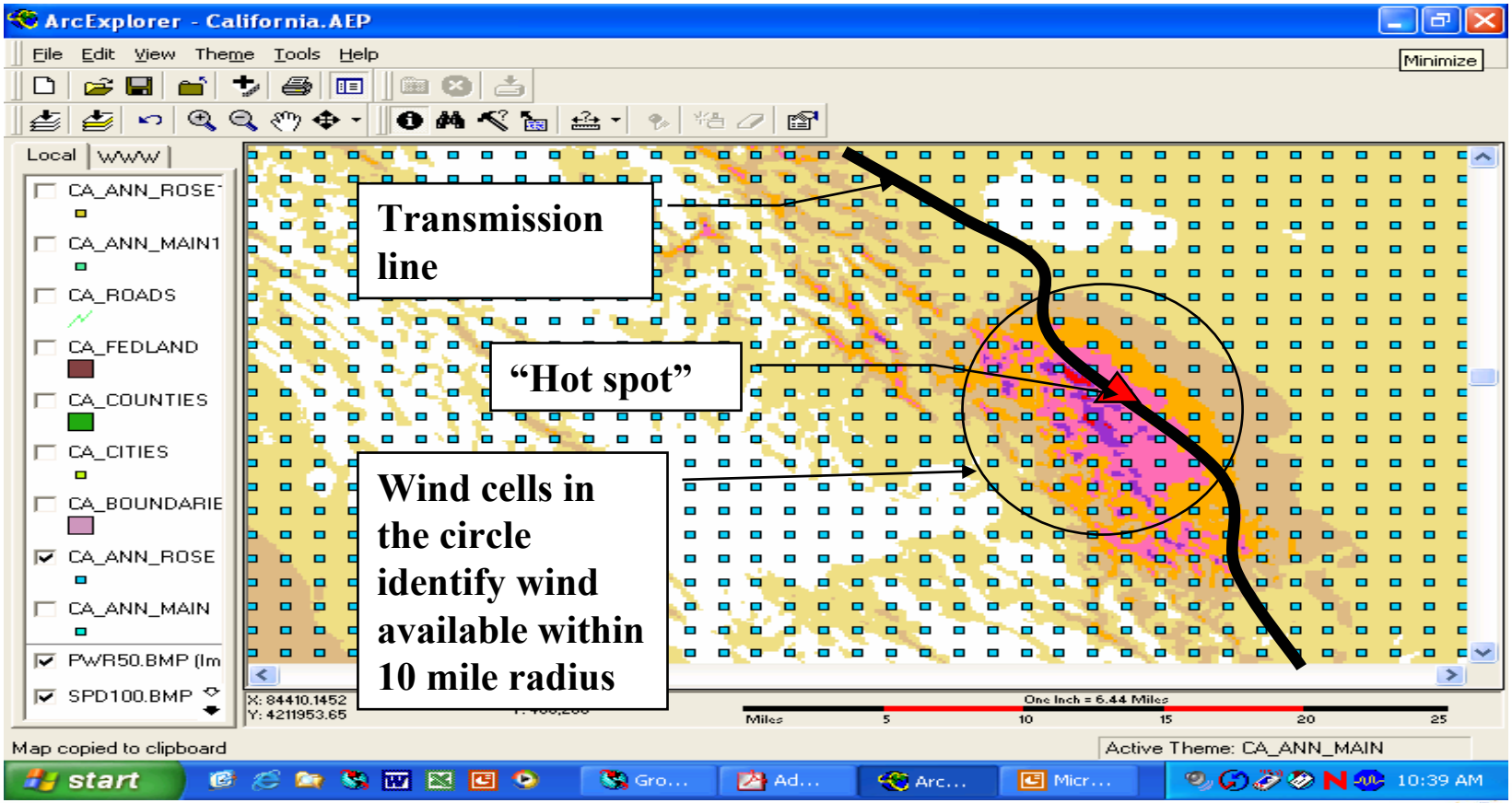
Visual Graphing of Cost of Wind Energy



Mapping Renewables to Hot Spots

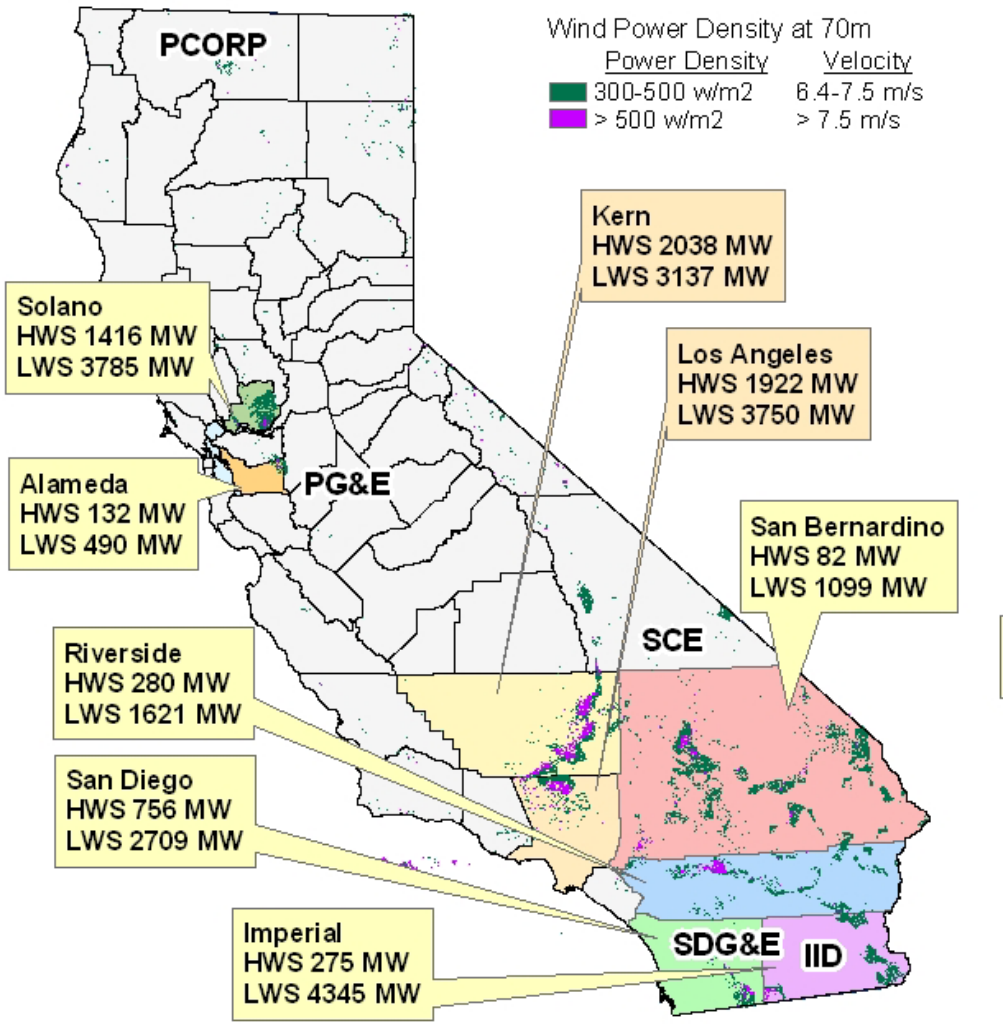
- ***Electricity Analysis***
  - ***Identifies "hot spots" and magnitude of problem***
    - ***WTLR indicates extent to which solution helps the overall system***
    - ***MW solution quantifies and places the solutions on a geographically precise basis***
      - ***Important in obtaining realistic estimates of solutions and costs***
- ***Mapping Renewables to Hot Spots***
  - ***Assesses if sufficient renewables are located in proximity to "hot spots"***
    - ***Enables transmission upgrades and costs to be identified***

Simplified Example of Mapping Wind Resources to Hot Spots



PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

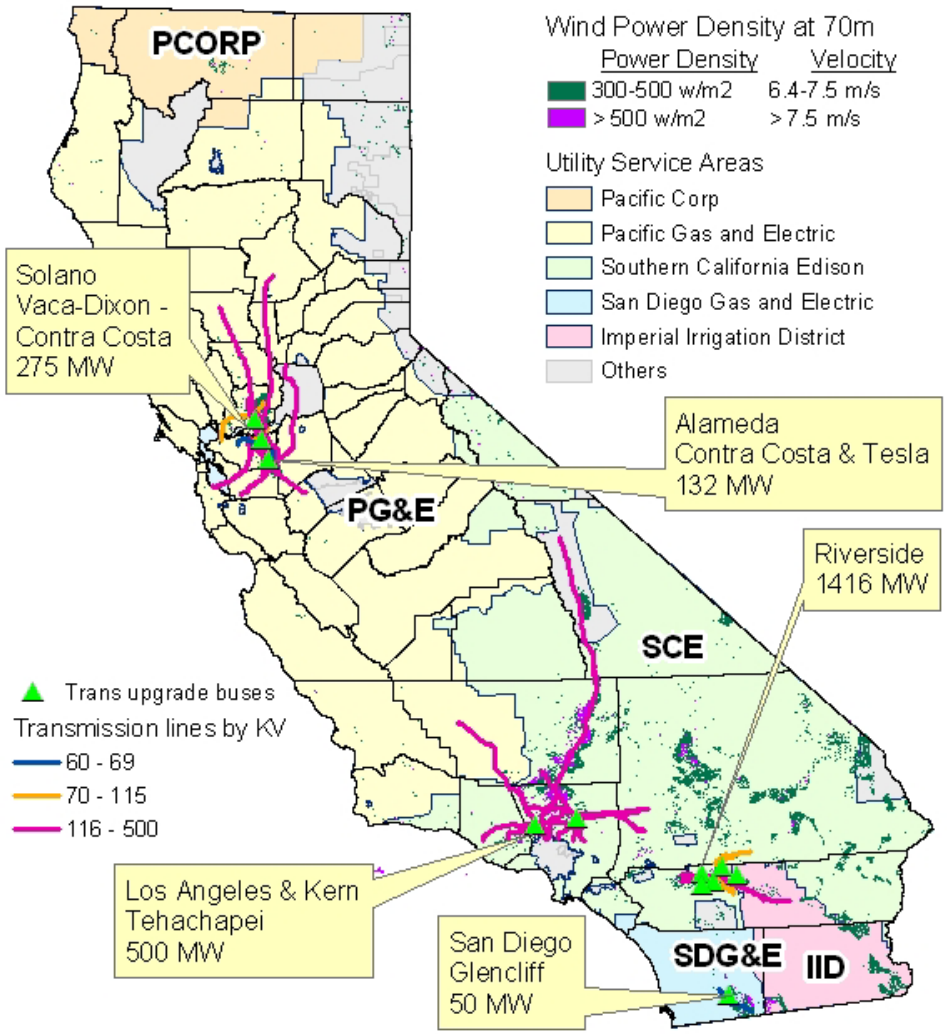
CA Wind Potential
High and Low Wind Speeds



Potential before looking at the feasibility and economics of connecting to the grid

pier
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

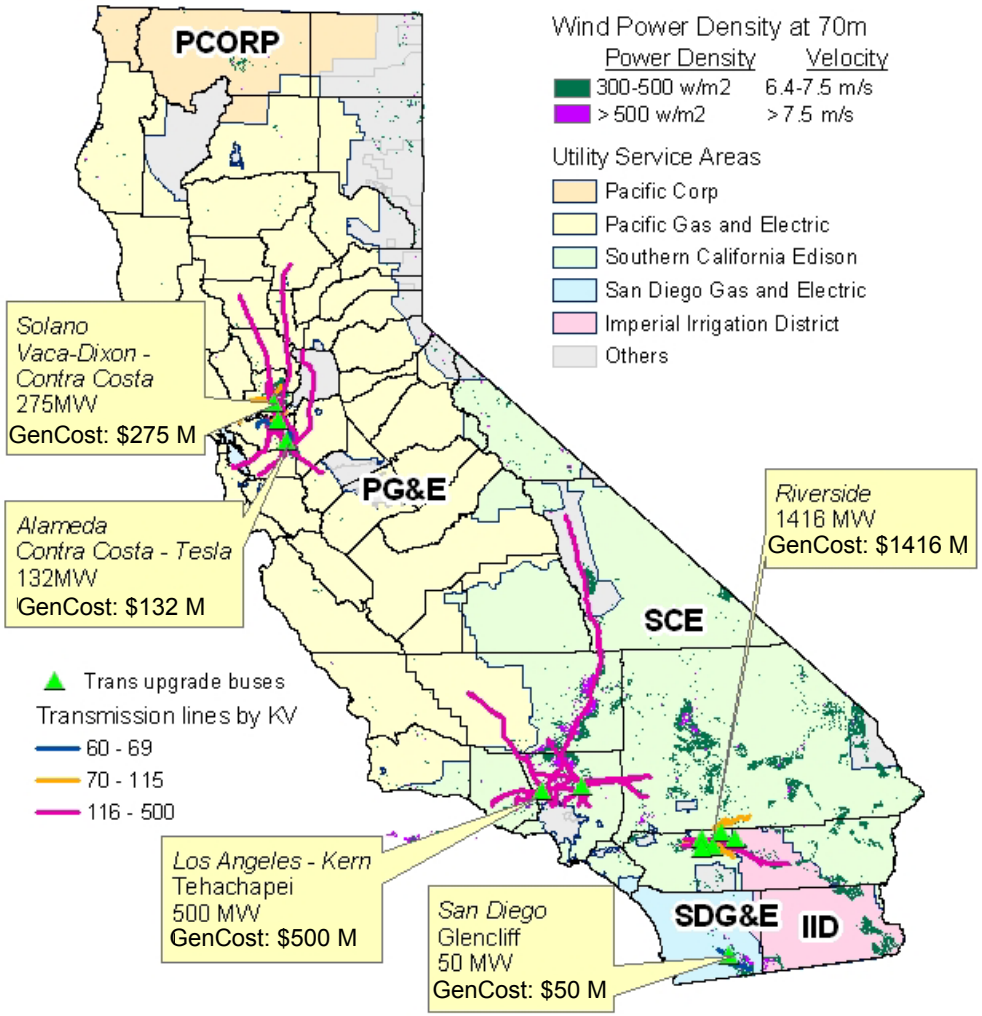
Projected Wind Generation Viable by 2010



These capacity additions were based on only those high speed wind resources within proximity to existing transmission access

PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

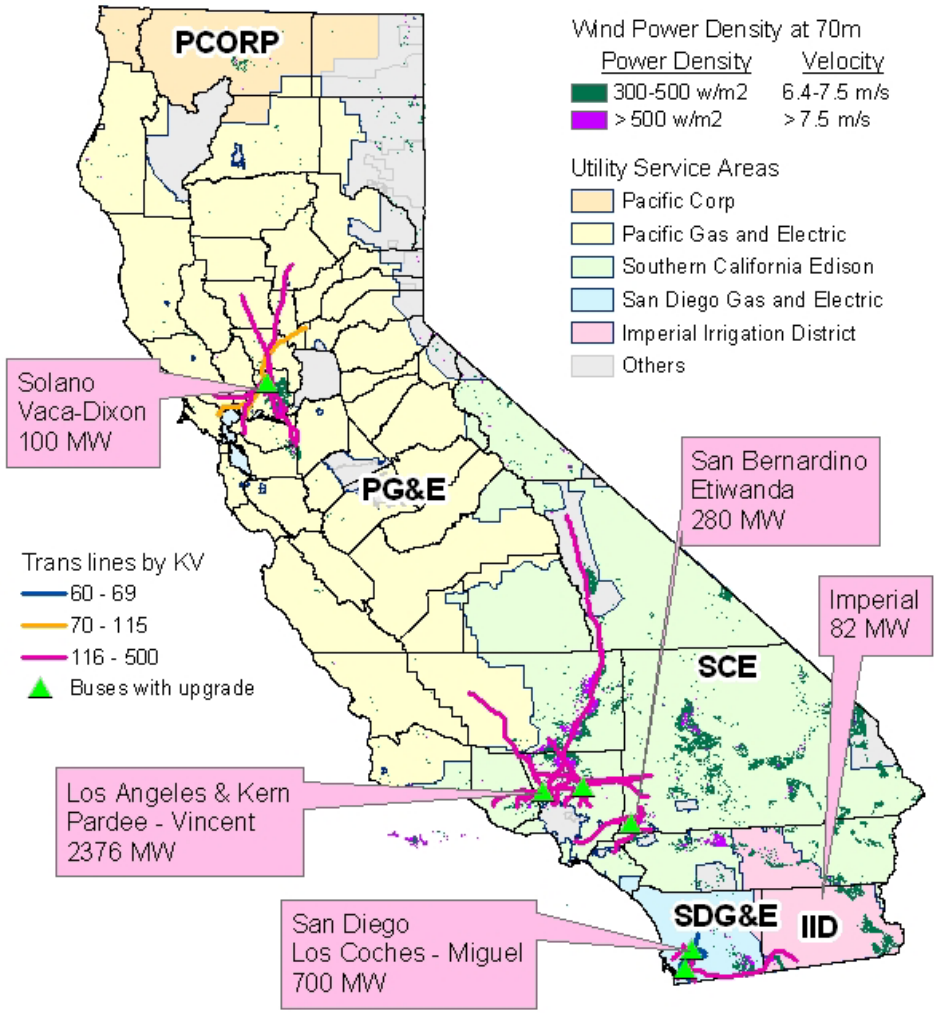
Wind Generation Capacity and Costs by 2010



Note there are no transmission costs as these capacity additions can occur without major transmission upgrades

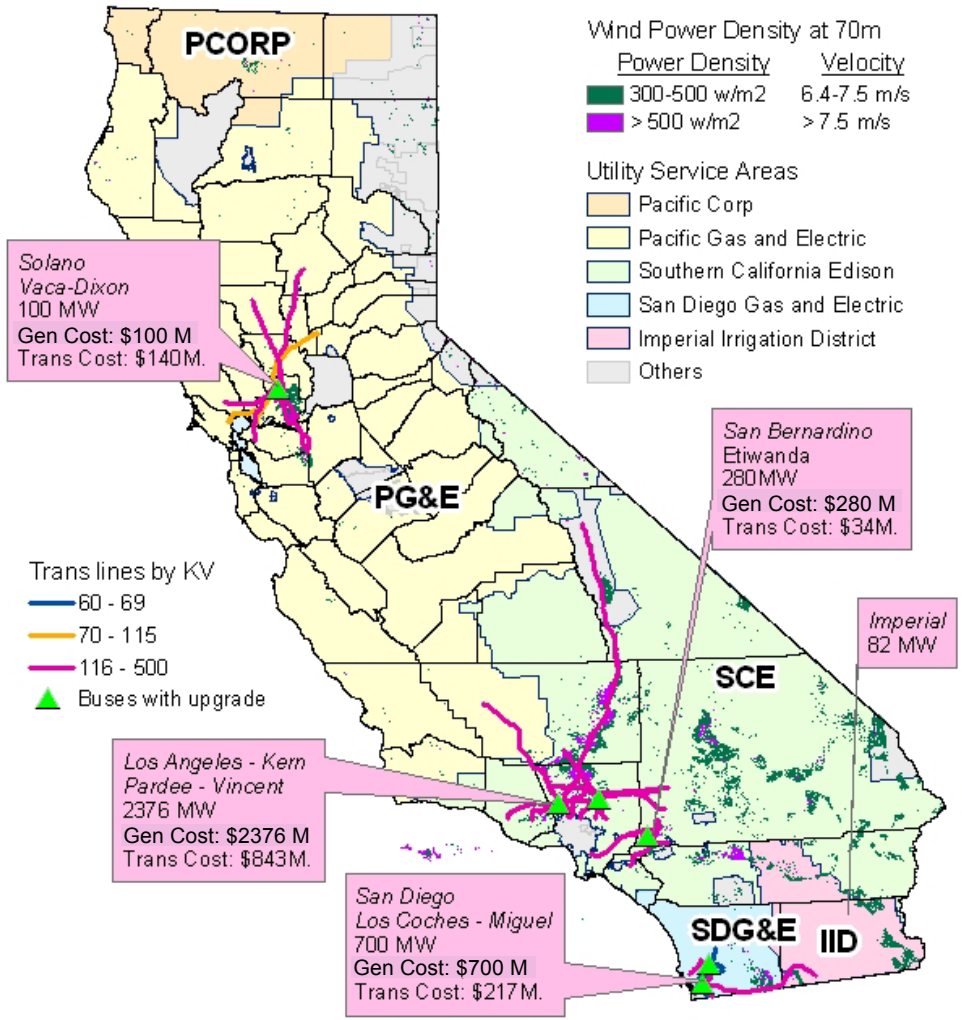
Total capacity additions at ~2370 MW and total cost of $2.4 billion

Projected Wind Generation Viable by 2017

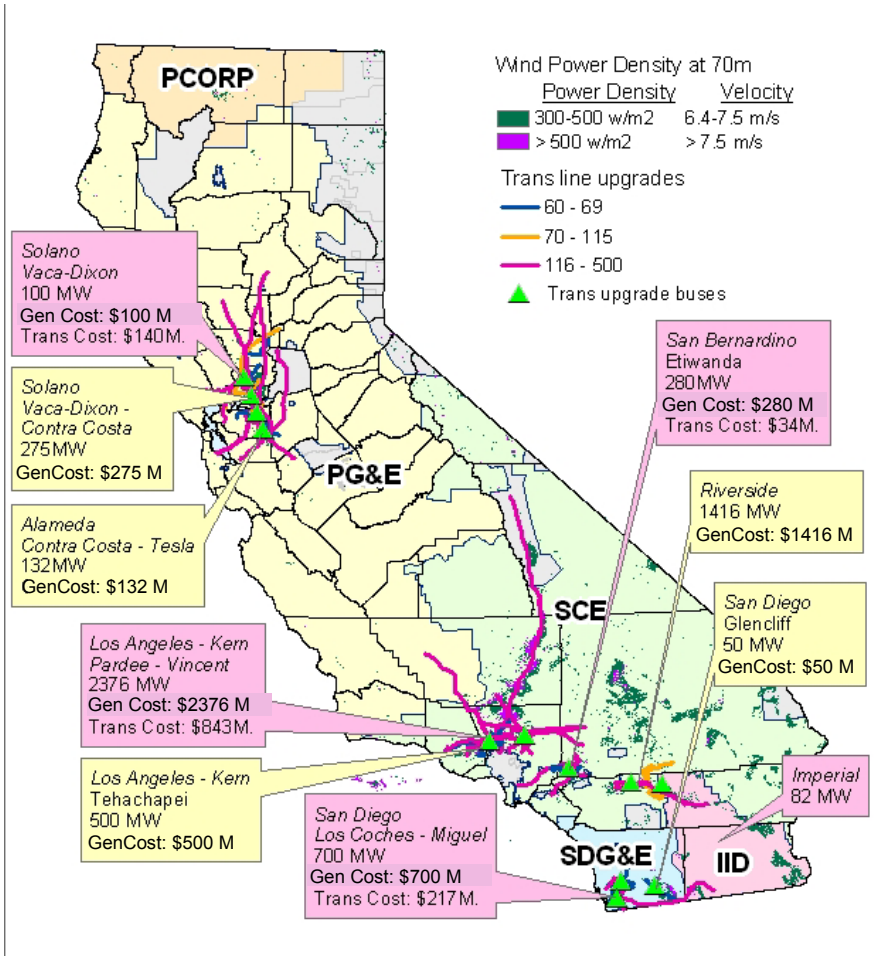


Total of over 3500 MW by 2017

Wind Generation Capacity and Costs by 2017

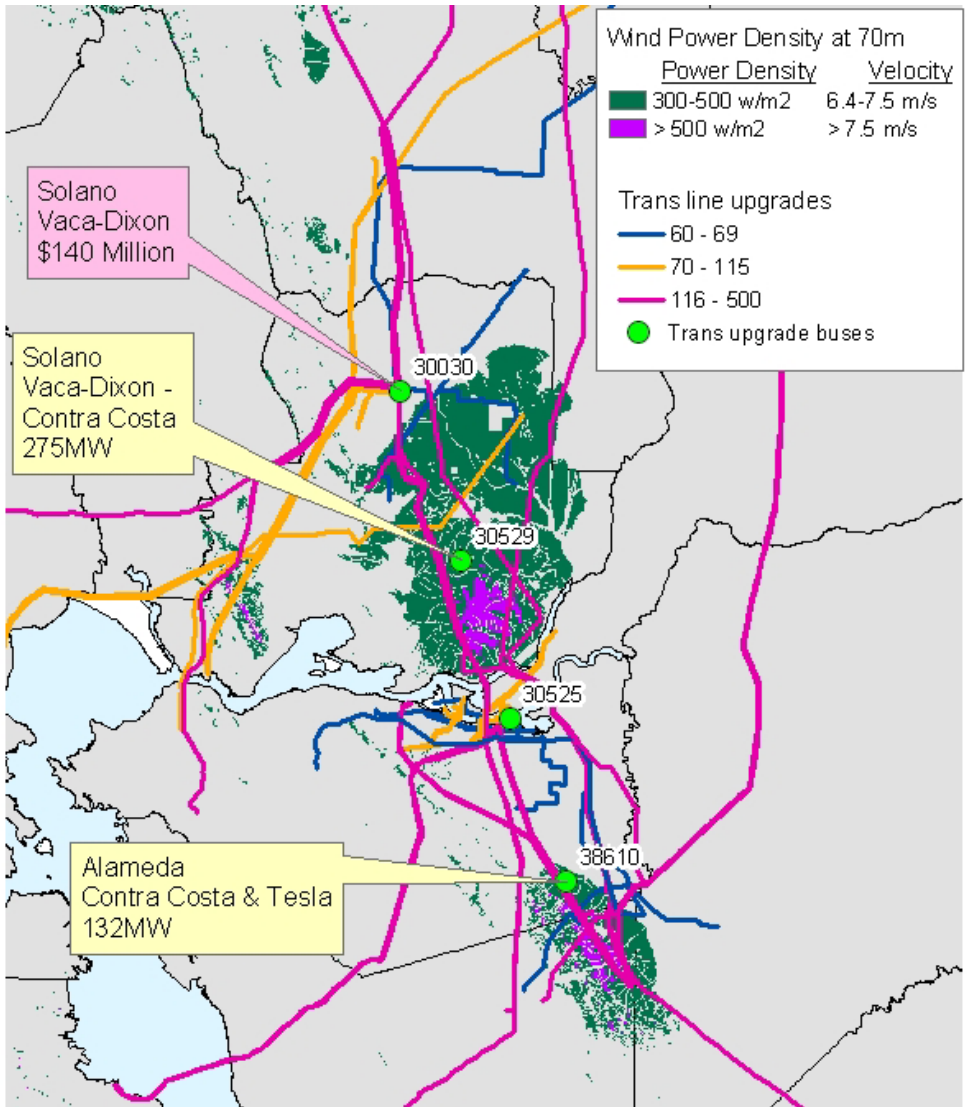


Combined 2010 and 2017 Wind Development Prospects



2010 developments in yellow; 2017 in pink

Detail on Solano Wind Developments



PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

Detail on Southern CA Wind Developments